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ABSTRACT

This guide is designed for use in helping junior and senior high school students explore the field of electricity and electronics as a potential career area. Included in the manual are the following materials: definitions, a key to the organization and numbering code and symbols used in the lists of objectives, lists of general and program objectives with recommended instructional levels, a flow chart detailing the organizational pattern of the course of study to prepare students for careers in electricity and electronics, descriptions of pertinent required and elective courses, suggested facilities layouts, guidelines for classroom safety and health, a discussion of strategies for mainstreaming disabled students through the development of individualized educational programs (IEPs), a competency profile for vocational teachers instructing sensory and physically impaired students, a self-assessment evaluation form for teachers, a sample certificate of completion, and a brief list of basic textbooks. (MN)

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Electricity And Electronics Objectives

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career education

DS Manual 2875.1
April 1984

ELECTRICITY AND ELECTRONICS OBJECTIVES

Department of Defense Dependents Schools

CE043579

CAREER EDUCATION

FOREWORD

Electricity and Electronics in the Department of Defense Dependents Schools (DoDDS) is a career education discipline which provides opportunities for students in junior high and high schools to be involved in both introductory and advanced programs. Approximately 25 schools offer Electricity and Electronics Programs.

The exploratory electricity and electronics program affords junior high students motivational and manipulative experiences to arouse interest and curiosity as a potential career area. A variety of learning experiences are presented to the student.

The high school program also affords the students exploratory experiences as well as industrial, technical, and consumer skills. The students learn through hands-on learning experiences, problem solving, and use of tools and test equipment.

This manual provides program and instructional objectives as guidelines for the teaching of electricity and electronics.

Steve Motta
Deputy Director

ACKNOWLEDGEMENTS

The Electricity/Electronics Objectives Manual is a revised version of the 1980 document. We appreciate the efforts of the many DoDDS educators who helped prepare that original document.

During SY 1983-84, educators from three regions - Mediterranean, Germany, and Panama, were tasked to review and revise the Electricity/Electronics Objectives. DoDDS is indebted to the many persons from throughout the system who contributed to this document and particularly to the following educators:

Raymond Babineau
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INTRODUCTION

The Electricity/Electronics program presents an opportunity for all students at all grade levels to explore the wide spectrum of the electrical and electronic occupational areas.

The Electricity/Electronics program also provides the information and experience necessary for the student to build a foundation of knowledge required to understand and apply electricity and electronics to practical situations. Emphasis is placed upon the student as a learner who can develop specific knowledge and skills in understanding the use of electricity and electronics.

The Electricity/Electronics Program considers the needs, capabilities, background, and interests of each student enrolled. Instruction is, therefore, individualized to the greatest extent possible, considering the time and resources available. The routine classroom lecture should be reduced in its role as the primary teaching method. It should be used mainly to introduce broad areas and should permit the students to discover details in small groups or on their own. Individualized learning depends heavily upon self-instructional materials, audiovisual learning aids, and student assistants.

The instructor prescribes the framework and procedures whereby the learner can accomplish the terminal performance objectives which will be consistent with the entry-level requirements for the career goal.

DEFINITION OF ELECTRICITY/ELECTRONICS

The Electricity/Electronics program provides students the opportunity to explore the occupational area encompassing this field. In addition, the student will gain entry-level skills required in high technology or to serve as a prerequisite for further study after high school.

The following terms are defined.

Electrical - The study of house wiring, commercial wiring, lighting, appliances, and industrial controls of heavy load applications.

Electronic - The study of devices used in electronic systems; i.e., radios, TV, radar, computers, and communication systems.

Digital - Applies to the study of digital integrated circuits.

Microprocessors - An electronic system which is the center of digital applications. Although the microprocessor is the heart of a digital computer, it applies to other various applications, particularly in industrial applications.

Industrial electricity - An extensive study of industrial control circuits and systems, giving special treatment to solid state controls, electromechanical devices, and transducers.

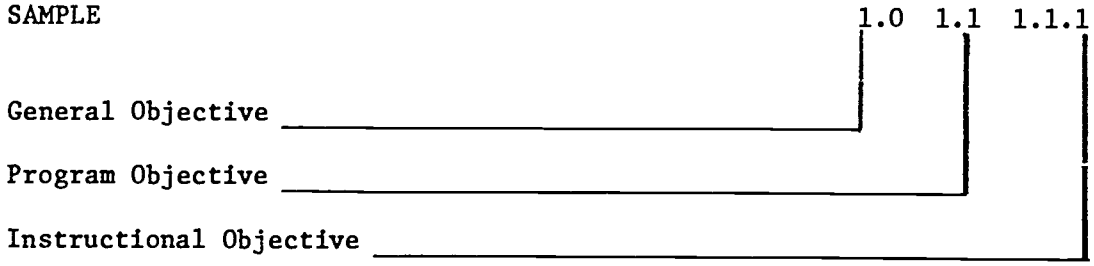
Robotics - The use of automated machinery controlled by digital systems to facilitate high technology industrial tasks.

Communications - The study of radar, microwave, telemetric A.M. and F.M. transmission, and data transfer systems over long distances.

ORGANIZATION AND NUMBERING CODE

The numbering code is used to indicate the levels of the objective.

SAMPLE 1.0 1.1 1.1.1



The first digit of the number of each statement refers to the general objective.

The second digit refers to the program objective.

The third digit refers to the instructional objective.

Instructional objectives are not to be considered inclusive, but are only presented as examples.

The numbering code is used to facilitate:

Identification of objectives.

Correlation of objectives with textbook and instructional materials.

Matching of test items to objectives.

USE OF SYMBOLS

Within the recommended instructional levels, the letter E represents the suggested entry point at which instruction begins.

The letter P indicates the level at which proficiency would normally be excpected.

All General, Program, and Instructional Objectives should be read with the understanding that they are preceded by the phrase, "The learner should...."

SAMPLE INSTRUCTIONAL OBJECTIVE	RECOMMEND INSTRUCTIONAL LEVELS				
	6 - 8	9	10	11	12
Develop a basic technical vocabulary.	E	P			
Compare consumer product specifications.		E			P

GENERAL AND PROGRAM OBJECTIVES

GENERAL OBJECTIVE: 1.0 APPRECIATE THE ROLE OF ELECTRICITY/ELECTRONICS IN A HIGH TECHNOLOGICAL SOCIETY.

PROGRAM OBJECTIVE: 1.1 Develop an awareness of the rapid evolution taking place in this highly technical field.

INSTRUCTIONAL OBJECTIVE	RECOMMENDED INSTRUCTIONAL LEVELS 6 - 8	9	10	11	12
1.1.1 Define ways in which electrical technology has been adopted.	E___P				
1.1.2 Relate societal changes to electrical technical advancements.	E___P				
1.1.3 Describe how advancements in electronic technology have influenced industrial development.	E___P				
1.1.4 Categorize the various impacts of "high tech" revolution on the manufacturing techniques.	E___P				

PROGRAM OBJECTIVE: 1.2 Investigate the opportunities in the electronics career fields.

INSTRUCTIONAL OBJECTIVE		RECOMMENDED INSTRUCTIONAL LEVELS 6 - 8	9	10	11	12
1.2.1	Develop a basic technical vocabulary.	E P				
1.2.2	Describe the major tasks that a worker performs in specific electronic careers.	E P				
1.2.3	Differentiate entry-level skills required in different electronic careers.	E		P		
1.2.4	Describe the working conditions of several jobs in the electronics industry.	E P				

PROGRAM OBJECTIVE: 1.3 Develop abilities to be a better consumer.

INSTRUCTIONAL OBJECTIVE		RECOMMENDED INSTRUCTIONAL LEVELS 6 - 8	9	10	11	12
1.3.1	Investigate the quality of various consumer items.	E				P
1.3.2	Compare consumer product specifications.		E			P
1.3.3	Compare performance of electronic consumer products.	E	P			

GENERAL OBJECTIVE: 2.0 EXPLAIN THE USE OF BASIC HAND TOOLS, TEST EQUIPMENT, AND SAFETY PROCEDURES.

PROGRAM OBJECTIVE: 2.1 Demonstrate the use of hand tools.

		RECOMMENDED INSTRUCTIONAL LEVELS				
INSTRUCTIONAL OBJECTIVE		6 - 8	9	10	11	12
2.1.1	Identify tools and equipment used in the electrical trades.	E P				
2.1.2	Select tools for the job.	E P				
2.1.3	Use tools safely.	E P				

PROGRAM OBJECTIVE: 2.2 Demonstrate the use of test equipment.

INSTRUCTIONAL OBJECTIVE		RECOMMENDED INSTRUCTIONAL LEVELS 6 - 8	9	10	11	12
2.2.1	Select test equipment for the job.		E			P
2.2.2	Operate test equipment to measure parameters in a functioning circuit.		E			P
2.2.3	Use test equipment safely.		E			P

PROGRAM OBJECTIVE: 2.3 Maintain safety awareness.

INSTRUCTIONAL OBJECTIVE		RECOMMENDED INSTRUCTIONAL LEVELS 6 - 8	9	10	11	12
2.3.1	Apply safety rules applicable to hand tools and machinery.	E___P				
2.3.2	Integrate safe working habits and attitudes into a laboratory environment.	E___P				
2.3.3	Demonstrate clean-up and storage procedures.	E___P				
2.3.4	Identify procedures of first aid.	E___P				
2.3.5	Describe safety for emergency use in the lab area.	E_____P				
2.3.6	Identify safety violations in the laboratory.	E___P				

GENERAL OBJECTIVE: 3.0 DEVELOP PROBLEM SOLVING ABILITIES AS RELATED TO ELECTRICAL/ELECTRONIC PHYSICAL LAWS.

PROGRAM OBJECTIVE: 3.1 Identify skills in the field of electricity and electronics.

INSTRUCTIONAL OBJECTIVE		RECOMMENDED INSTRUCTIONAL LEVELS 6 - 8	9	10	11	12
3.1.1	Construct circuits showing the applications of transducers.	E P				
3.1.2	Identify the applications and efficient use of the various forms of energy.	E P				
3.1.3	Identify electrical components and their schematic diagrams.	E P				
3.1.4	Interpret electrical schematic diagrams in the wiring of high and low voltage devices.		E P			

PROGRAM OBJECTIVE: 3.2 Apply the concepts of D.C., A.C., and magnetism to basic circuits.

INSTRUCTIONAL OBJECTIVE		RECOMMENDED INSTRUCTIONAL LEVELS 6 - 8	9	10	11	12
3.2.1	Describe ways in which electrical energy can be changed into other forms of energy.	E P				
3.2.2	Analyze basic electrical components and their schematic diagrams.		E P			
3.2.3	Construct electrical circuits from schematic diagrams and make measurements necessary to mathematically analyze the circuit.		E P			
3.2.4	Identify common electronic components, their symbols, and electronic circuits.		E P			
3.2.5	Interpret simple schematic diagrams and written procedures in setting up and troubleshooting basic electronic circuits.		E P			
3.2.6	Select proper soldering equipment and techniques in soldering.		E P			
3.2.7	Demonstrate proper use of test equipment.		E P			
3.2.8	Use safety rules applicable to electronic equipment.	E P				
3.2.9	Apply electrical/electronic formulas to interpret A.C. and D.C. circuits.		E P			

PROGRAM OBJECTIVE: 3.3 Explain the principles of solid state devices used in basic circuits.

INSTRUCTIONAL OBJECTIVE		RECOMMENDED INSTRUCTIONAL LEVELS				
		6 - 8	9	10	11	12
3.3.1	Identify various solid state circuits, their symbols, and electronic specifications.		E_____P			
3.3.2	Calculate gain in a transistor amplifier.			E_____P		
3.3.3	Operate test equipment to measure parameters in a functioning circuit.			E_____P		
3.3.4	Identify solid state oscillators, amplifiers, regulators, and power supply circuits.			E_____P		
3.3.5	Construct solid state oscillators, amplifiers, regulators, and power supply circuits.			E_____P		
3.3.6	Test solid state oscillators, amplifiers, regulators, and power supply circuits.			E_____P		
3.3.7	Construct circuits showing the applications of active and passive devices, such as transistors, diodes, and capacitors.			E_____P		
3.3.8	Solve practice problems concerning laboratory measurements.			E_____P		
3.3.9	Operate various types of laboratory test equipment and tools needed for repairing electronic systems.			E_____P		

PROGRAM OBJECTIVE: 3.4 Analyze data in terms of conditions or laws that affect digital circuits.

INSTRUCTIONAL OBJECTIVE		RECOMMENDED INSTRUCTIONAL LEVELS 6 - 8	9	10	11	12
3.4.1	Describe the basic concepts of digital integrated circuits.			E		P
3.4.2	Analyze digital experiments using triggered dual trace oscilloscopes.			E		P
3.4.3	Use Boolean algebra to assist in simplifying digital circuits.			E		P
3.4.4	Describe the operation of logic gates.			E		P
3.4.5	Construct circuits using registers.			E		P
3.4.6	Demonstrate the use of shift registers, digital counters, decoders, and encoders.			E		P
3.4.7	Use parity bits for error detection, digital to analog, analog to digital conversion, and memory circuits (RAM and ROM).			E		P

PROGRAM OBJECTIVE: 3.5 Relate digital and organizational concepts to microprocessors.

INSTRUCTIONAL OBJECTIVE		RECOMMENDED INSTRUCTIONAL LEVELS 6 - 8	9	10	11	12
3.5.1	Use binary, octal, and hex number systems to program a microprocessor.				E____	P
3.5.2	Use machine language and instruction sets to program a microprocessor.				E____	P
3.5.3	Build circuits used to interface microprocessors with peripheral devices.				E____	P
3.5.4	Use test equipment to determine operation of microprocessor systems.				E____	P
3.5.5	Conduct experiments in computer arithmetic and programming, using a microprocessor.				E____	P

PROGRAM OBJECTIVE: 3.6 Relate basic concepts associated with robotics and industrial electronics.

INSTRUCTIONAL OBJECTIVE		RECOMMENDED INSTRUCTIONAL LEVELS 6 - 8	9	10	11	12
3.6.1	Relate basic concepts to robotic technology.				E___P	
3.6.2	Identify hardware that controls a robot's voice and movements.				E___P	
3.6.3	Describe terminology associated with robots.				E___P	
3.6.4	Relate microprocessor fundamentals to the control of robots.				E___P	
3.6.5	Explain the A.C. and fluidic power principles in the operation of robots.				E___P	
3.6.6	Apply the theories of D.C. power and positioning to the operation of robots.				E___P	
3.6.7	Apply the principles of data acquisition.				E___P	
3.6.8	Apply the principles of data handling and conversion.				E___P	
3.6.9	Demonstrate the principles of voice synthesis.				E___P	
3.6.10	Program a robot to perform a task.				E___P	

PROGRAM OBJECTIVE: 3.7 Relate basic concepts associated with consumer electronics.

INSTRUCTIONAL OBJECTIVE		RECOMMENDED INSTRUCTIONAL LEVELS 6 - 8	9	10	11	12
3.7.1	Apply concepts related to tape recorders and video tape recorders.				E___	P
3.7.2	Interpret block diagrams and schematics of typical audio and video tape recorders.				E___	P
3.7.3	Select sequential steps in troubleshooting audio and video tape recorders.				E___	P
3.7.4	Apply concepts related to home computer systems.				E___	P
3.7.5	Interpret block diagrams and schematics of a typical home computer system.				E___	P
3.7.6	Demonstrate knowledge in trouble-shooting disc drive and printer systems.				E___	P
3.7.7	Demonstrate knowledge in hook up and troubleshooting of home microprocessors.				E___	P
3.7.8	Define the operation of the circuits of a TV receiver.				E___	P
3.7.9	Demonstrate use of test equipment to analyze the various waveforms for each section of a TV receiver.				E___	P
3.7.10	Describe the shock hazards involved with high voltage inside a TV receiver.				E___	P

3.7.11	Select the sequential steps in diagnosing a faulty TV receiver.	E____P
3.7.12	Interpret schematics in analyzing TV receivers for repairing and testing.	E____P

PROGRAM OBJECTIVE: 3.8 Describe the principles involved in electronic communications.

INSTRUCTIONAL OBJECTIVE		RECOMMENDED INSTRUCTIONAL LEVELS 6 - 8	9	10	11	12
3.8.1	Define the principles of modulation.				E____	P
3.8.2	Interpret block diagrams of single side band receivers and transmitters (amateur or commercial).				E____	P
3.8.3	Identify the FCC regulations pertaining to operation of amateur and commercial radios.				E____	P
3.8.4	Define the operation of circuits in an AM system.				E____	P
3.8.5	Align an AM receiver.				E____	P
3.8.6	Select the sequential steps in diagnosing a faulty AM receiver.				E____	P
3.8.7	Define the operation of circuits in an FM system.				E____	P
3.8.8	Select the sequential steps in diagnosing a faulty FM receiver.				E____	P

PROGRAM OBJECTIVE: 3.9 Explain methods the procedures involved in electrical wiring.

INSTRUCTIONAL OBJECTIVE		RECOMMENDED INSTRUCTIONAL LEVELS 6 - 8	9	10	11	12
3.9.1	Identify ways of conserving electrical energy.	E P				
3.9.2	Identify safe practices for working with electrical equipment.	E P				
3.9.3	Identify faulty electrical circuits.		E P			
3.9.4	Repair faulty electrical circuits.		E P			
3.9.5	Compute electrical energy costs.		E P			
3.9.6	Perform wiring activities dealing with commercial and residential wiring, sign display wiring, burglar and fire protection alarms, and fixture and receptacle planning.		E P			
3.9.7	Demonstrate the methods of electrical assembly.		E P			
3.9.8	List the types of motors and how they are used.			E P		

PROGRAM OBJECTIVE: 3.10 Describe the procedures involved in industrial electricity.

INSTRUCTIONAL OBJECTIVE		RECOMMENDED INSTRUCTIONAL LEVELS 6 - 8	9	10	11	12
3.10.1	Test basic motor control circuits.	E				P
3.10.2	Identify components of industrial control systems and schematic diagrams.		E			P
3.10.3	Interpret schematic diagrams in setting up experiments using the components of industrial control systems.		E			P
3.10.4	List the advantages of electrical/ mechanical and solid state control devices.			E		P
3.10.5	Construct industrial control systems.			E		P
3.10.6	Use test equipment for trouble-shooting circuits.		E			P
3.10.7	Use skills in motor troubleshooting, maintenance, wiring connections, measurement, and testing.		E			P

GENERAL OBJECTIVE: 4.0 INTEGRATE SKILL, ATTITUDES, AND KNOWLEDGE NECESSARY FOR SUCCESS AND ADVANCEMENT IN THE ELECTRICAL/ELECTRONIC CAREER FIELDS.

PROGRAM OBJECTIVE: 4.1 Develop the generic skills needed for success in various types of positions in the electronics industry.

INSTRUCTIONAL OBJECTIVE		RECOMMENDED INSTRUCTIONAL LEVELS 6 - 8	9	10	11	12
4.1.1	Apply mathematical skills needed for knowledge of circuit theory.		E			P
4.1.2	Demonstrate communication skills needed for success in electronics.		E			P
4.1.3	Develop effective human relation skills for performance on the job.		E			P
4.1.4	Develop interpersonal skills among peers, customers, and management.		E			P

PROGRAM OBJECTIVE: 4.2 Value the personal and social significance of work.

INSTRUCTIONAL OBJECTIVE		RECOMMENDED INSTRUCTIONAL LEVELS 6 - 8	9	10	11	12
4.2.1	Work independently with minimal supervision.		E			P
4.2.2	Demonstrate punctuality in class-related activities.		E			P
4.2.3	Demonstrate cooperation in group activities.		E			P
4.2.4	Accept responsibility for one's own behavior.		E			P
4.2.5	Respect differences of race, religion, culture, sex, and age.		E			P

PROGRAM OBJECTIVE: 4.3 Formulate a plan based on an occupational choice with consideration given to one's ability and the ever changing skills in the industry.

INSTRUCTIONAL OBJECTIVE		RECOMMENDED INSTRUCTIONAL LEVELS 6 - 8	9	10	11	12
4.3.1	Identify the various occupational fields within electricity/ electronics.		E			P
4.3.2	Explain characteristics in different areas of the electrical/electronics field and the skills needed for success.		E			P
4.3.3	Explain the interrelationship of careers in the field and traditional subject areas.		E			P
4.3.4	Identify promotional and job opportunities in the field.		E			P
4.3.5	Explain one's own limitations in a particular field.		E			P
4.3.6	Relate personal characteristics to occupational requirements.		E			P
4.3.7	Synthesize from appropriate data the electrical/electronic careers that will be offered in the near future.		E			P

TIME ALLOTMENTS FOR ELECTRICITY/ELECTRONICS PROGRAMS

The determination of time allotments needed for the study of Electricity/ Electronics Programs at various levels is an important consideration for the development of high technology offerings within the total school program. The fact that these programs can contribute significantly to individual student development necessitates articulation in all curriculum areas.

The length of Electricity/Electronics Programs in the middle/junior high and senior high schools is based on content. The content of general programs should be structured to permit individual students' participation regardless of prior experiences. Social, psychological, and psychomotor needs of the individual must be built into time allotments at the school level with assistance from school specialists. The following are recommended minimum time requirements for all students.

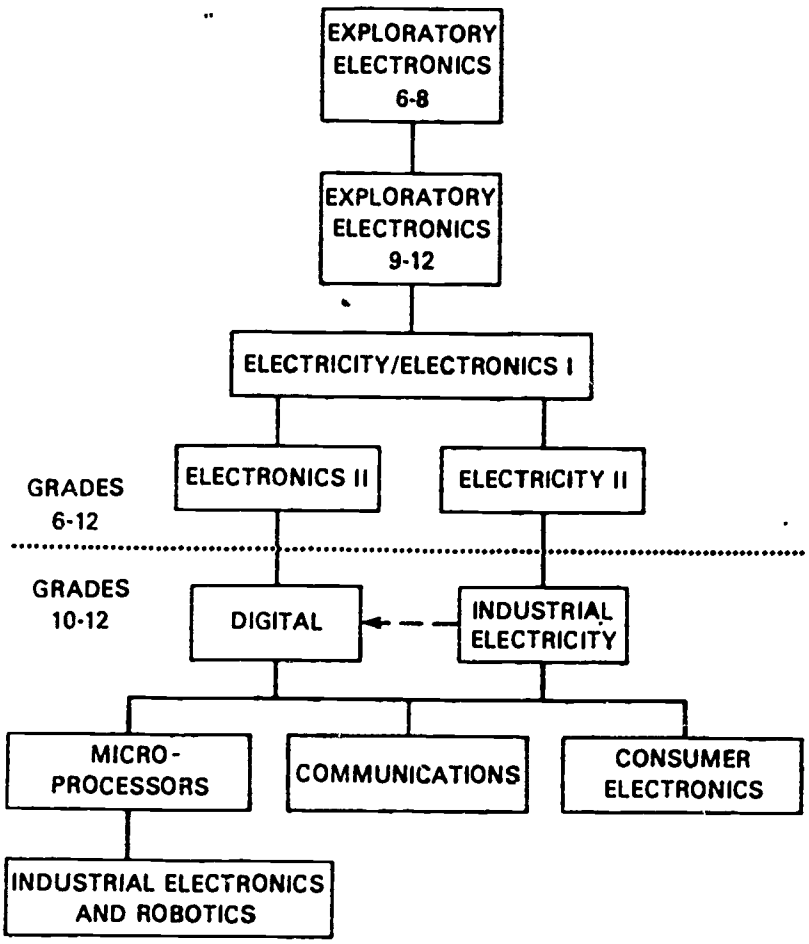
MINIMUM RECOMMENDED TIME REQUIREMENTS

Exploratory Electronics, Grades 6 - 8	9 weeks
Exploratory Electronics, Grades 9 - 12	9 weeks
Electricity/Electronics I	18 weeks
Electricity II	18 weeks
Electronics II	18 weeks
Digital Electronics	18 weeks
Industrial Electricity	18 weeks
Consumer Electronics	18 weeks
Microprocessors	18 weeks
Communications	18 weeks
Robotics and Industrial Electronics	36 weeks

EXPLANATION OF ORGANIZATIONAL CHART

The unique range of objectives in a high technology field such as electricity/electronics is best achieved in DoDDS by an organization composed of an exploratory program for grades 6-8 and a basic Electricity/ Electronics I course which supply the students with a fundamental knowledge which they can enlarge upon as they progress through the other courses. Two directions may be taken: one is high-technology, culminating in robotics, and the other is a program for the less mathematically- or science-oriented students.

ORGANIZATIONAL PATTERN FOR ELECTRICITY/ELECTRONICS COURSES



DESCRIPTION OF ELECTRICITY/ELECTRONICS COURSES OF STUDY

Junior High School
7-8
EXPLORATORY PROGRAM

The 7-8 grade electricity/electronics course is a nine-week or one-semester exploratory program that affords the student hands-on experience. The course is designed to motivate students toward further interest in the field of electricity and electronics.

High School
9-12
Electricity/Electronics
EXPLORATORY PROGRAM

The 9-12 grade electricity/electronics exploratory course provides an introduction by exploratory hands-on activities in basic electricity and electronics. It is designed to familiarize students with the occupational area of electricity/electronics, utilizing laboratory experiments in basic circuits and wiring.

ELECTRICITY/ELECTRONICS I

This course provides students with a solid background in D.C. circuit concepts, A.C. circuit concepts, and magnetism fundamentals. It includes interpreting schematic diagrams in setting up and troubleshooting basic electrical/electronic circuits. The student will use test equipment to analyze basic resistive, inductive, and capacitive circuits. Application of safety rules and safe work habits will be stressed throughout the course.

ELECTRICITY II

Introduces the student to the basic circuits used in lighting, appliances, relays, and motor control. Basic electrical instruments are examined. High motivation is achieved through early hands-on lab activities. Training will take place on actual electrical equipment and trainers specifically designed to give students situations as near to actual working conditions as possible. Prerequisite: Electricity/Electronics I.

ELECTRONICS II

This course covers active solid-state devices and their uses and applications in the various electronics fields. Diodes, transistors, and special solid state devices are analyzed in-depth with sophisticated test equipment. Basic circuits, including amplifiers, power supplies, and oscillators, are examined and their applications to more complex circuits are studied.

DIGITAL ELECTRONICS

Digital electronics familiarizes the student with the highly technical area of special integrated circuits used in digital logic. The study of logic circuits, registers, arithmetic logic units, D/A and A/D converters, encoders, decoders, and storage devices, prepares the student to enter the field of microprocessor and computer technology.

INDUSTRIAL ELECTRICITY

This course is divided into the study of the three principal types of controls used in industry. These are electrical-mechnical, transducers, and solid-state circuits. Beginning with a simple switch controlling a motor, progression is to switches controlling relays that control motors; use of indicator devices; solid state controllers; fluid control fundamentals; principles of robotics; and the use of temperature, light, pressure, and liquid level transducers utilized in industrial electricity.

CONSUMER ELECTRONICS

This course is designed to enable the student to understand the duties of the consumer electronics technician. Techniques used in the repair of AM/FM radios, TV, audio and video tape recorders, and home computer systems are included. Digital electronics should be a prerequisite for this course.

MICROPROCESSORS

This course covers all the basics of microprocessors, microcomputers, and programming. It includes hands-on hardware/memory interfacing and programming experiments. The course covers the following units: number systems/codes, microcomputer basics, computer arithmetic, introduction to programming, and interfacing.

COMMUNICATIONS

This course develops an understanding of broadcast and data communication fundamentals. Information including communication fundamentals, amplitude and frequency modulation circuits, single-sideband circuits, AM and FM detectors, superheterodyne receivers, pulse modulators, antennas, and transmitter/receiver communications systems is covered.

ROBOTICS AND INDUSTRIAL ELECTRONICS

This course covers the fundamentals of robot technology using programmed self-study materials. The units of instruction include robotic fundamentals, AC and fluid power, DC power and positioning, microprocessor fundamentals, robot programming, data acquisition (sensors), data handling and conversion, voice synthesis, interfacing, and industrial robots at work.

SUGGESTED FACILITIES LAYOUTS

The facilities descriptions and layout sketches following are intended only as guides. Any number of alternative facility plans could work equally well. For some schools, facilities for this program may already exist. In such cases, the following material may offer the instructor and administration some suggestions for making the facility more effective through minor alterations.

For other schools starting up a new program, it may be necessary to remodel existing facilities. In such cases, it should not be expected that the remodeled facilities will offer every advantage that can be achieved with new facilities.

If new facilities are to be provided, a school may be unable to support a complete laboratory either because of enrollment, space, staff, or financial limitations. In such cases, decisions must be made regarding minimum program essentials and facilities designed to fit.

Whether new or remodeled, facilities may serve multiple or joint functions. Thus, business and graphic production areas may be combined, art and graphics study areas could be shared, welding can be done in an auto shop, small engine and automotive shops can be combined, computer and business programs may share spaces, the various health and cosmetology programs can share a common suite, and the electronics laboratory could be combined with a physical science laboratory.

Such combinations have served to strengthen both programs. Students see the direct relationship of various and parallel fields. Faculty finds professional stimulation and mutual support in working with colleagues in previously artificially separated disciplines.

ELECTRONICS/ELECTRICITY LABORATORY

The electronics laboratory will house vocational courses in basic electronic theory and practice that will provide basic entry-level skills in the electricity/electronics career areas.

The recommended area of approximately 1,400 square feet should be subdivided into a general laboratory area, project storage (250 square feet) and equipment storage (150 square feet) (see functional zone sketch).

The project and equipment storage areas must provide secure storage. There should be adjustable shelving, 18 inches deep, from floor to ceiling on all available wall space.

There should be two wood-top electronics work benches on the walls at the ends of the benches. Students will stand when working at these benches. Benches should be 24 inches deep and should have closed storage underneath.

The general laboratory area should have 110- and 220-volt electrical outlets on eight-foot centers on all walls and in the center of the room. An under-floor grid system with relocatable outlet boxes is acceptable for floor-level service. There should be two master cut-off switches controlling all receptacles. One master switch should be located near the corridor door and one near the door leading to the teacher's office.

The general laboratory area should have a chalkboard, tack board, and sink with hot and cold water.

A lead-in from an outside television antenna should be provided on one work bench wall.

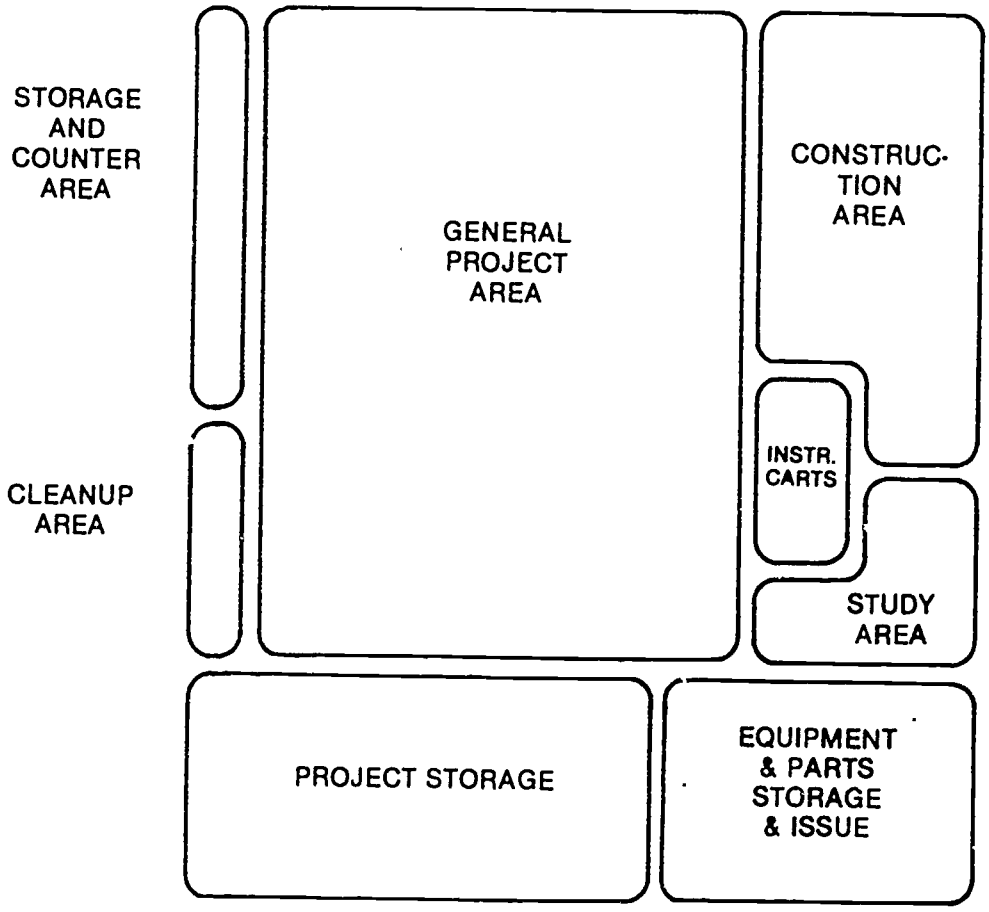
Illumination should provide a minimum of 50 foot-candles at desk-top height.

The laboratory should be capable of darkening for the use of visual aids.

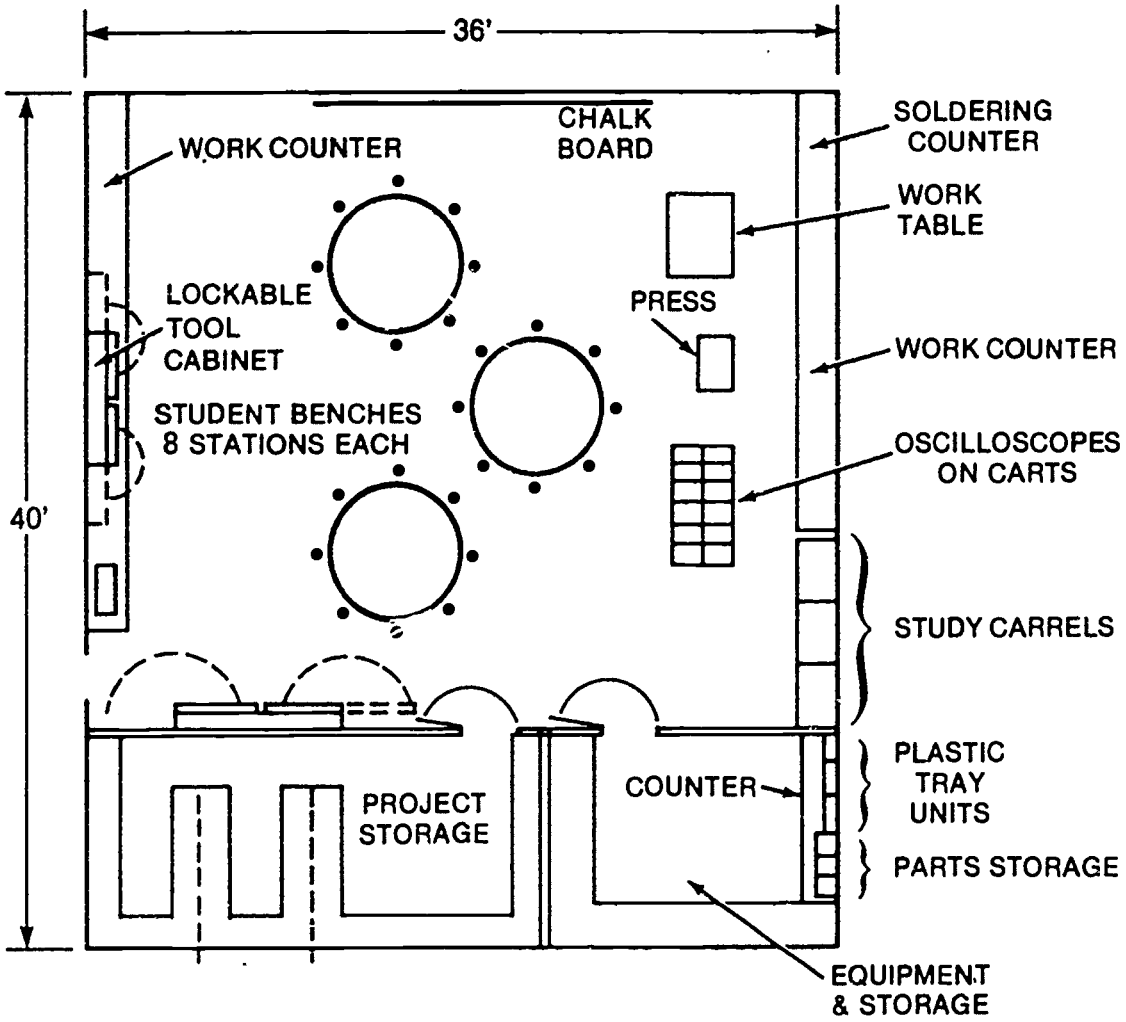
In the building that houses the electronics laboratory there should be provision for access to the roof where antennas will be installed for TV and radio reception, which will service the electronics laboratory. Antennas will be required for the equipment used. Students will install and service antennas.

The floor should have an insulation barrier over concrete to prevent grounding.

Suggested Electricity/Electronics Laboratory Functional Zones

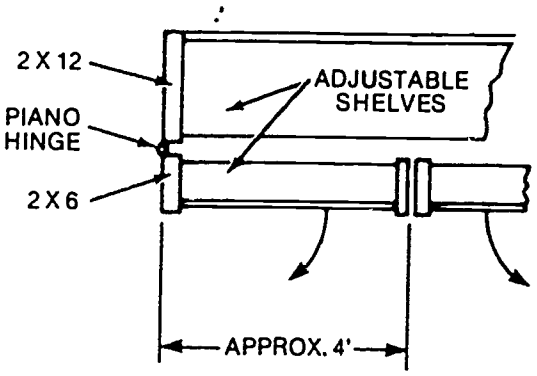


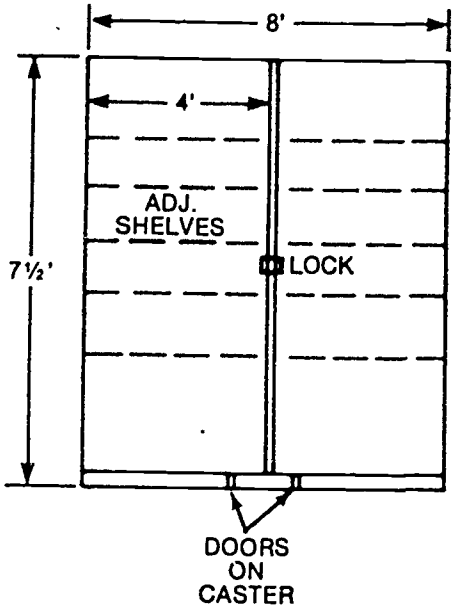
Suggested Electricity/Electronics Laboratory



Suggested Cabinet Detail
Electricity/Electronics Laboratory

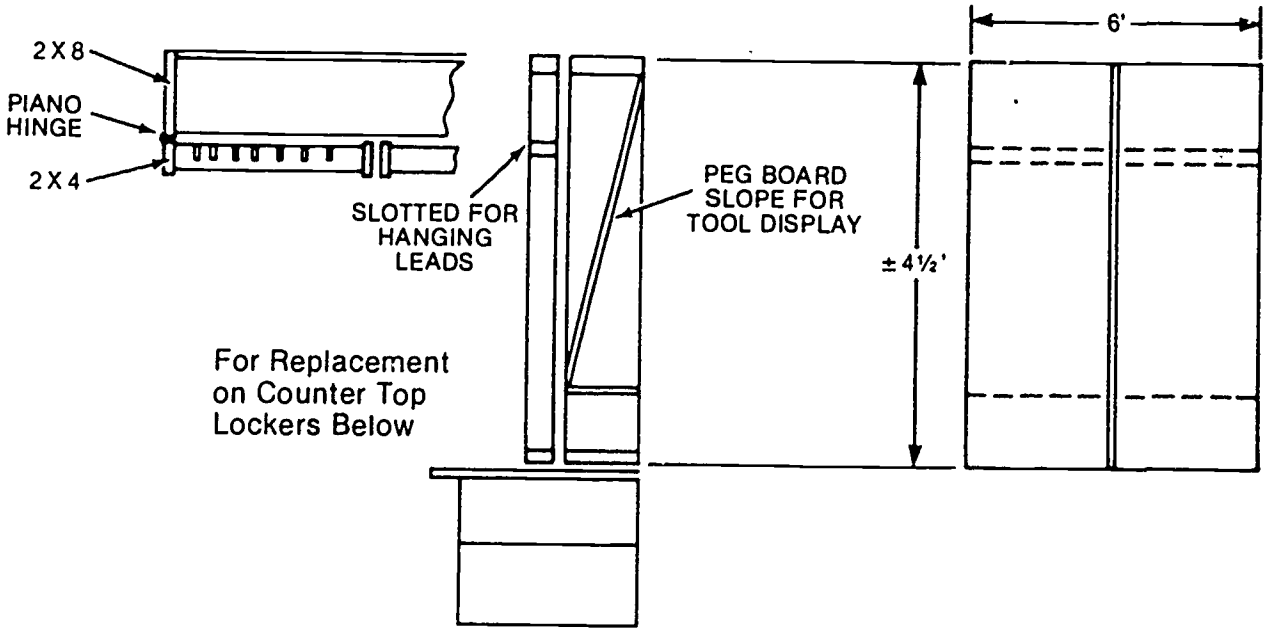
Lockable Equipment Cabinet





For Secure Storage of:
- — Meters
- — Signal Generators
- — Power Supplies
- — Similar Equip.

Lockable Tool Cabinet



SUGGESTED TEST EQUIPMENT NECESSARY TO PROVIDE AN EFFECTIVE ELECTRONICS PROGRAM FOR A MAXIMUM OF 20 STUDENTS PER PERIOD.

QUANTITY	ITEM
10	V.O.M.
10	D.M.M.
10	Function Gen.
10	Triggered O'Scope - Dual Trace
2	Freq Counter
5	RF Sig Gen
1	Color Bar Gen
1	Semi-conductor Tester
1	Grid Dip Meter
1	Signal Tracer
1	CRT Tester/Rejuvenator
5	Logic Probes
5	Pulsar Probes
1	Hi Voltage Probe

SUGGESTED TRAINING EQUIPMENT NECESSARY TO PROVIDE TRAINING TO 20 STUDENTS PER PERIOD.

QUANTITY	ITEM
1	Hydraulic TNR
1	Pneumatic TNR
2	Robots
10	Microprocessor TNRS
10	Digital TNRS
10	Expl. Elec TNRS
3	Practical Electronics Training System (8 student lab bench)
5	Residential House Wiring Trainers
5	Industrial Electricity Trainer

SAFETY AND HEALTH*

Safety is an important integral concept of the electrical/electronics field and must be emphasized for the protection of life and equipment.

PROGRAM - Learning experiences and activities are designed for the development of knowledge, skills, and attitudes concerning the safe use of tools, electrical test equipment, machines, and materials.

Teachers should prepare a written plan for a comprehensive safety program specifying:

1. The awareness of the dangers of electrical shock.
2. The use of eye protection devices when needed in certain tasks.
3. The use of ear protection devices when needed in certain tasks.
4. Safety instructions and information to be included with each laboratory assignment.
5. Safety procedures must be emphasized and enforced by the teacher.
6. Teachers and administrators should review each recorded accident and all unsafe practices to correct deficiencies.

PHYSICAL ENVIRONMENT - The physical facilities and equipment are designed, constructed, and maintained to ensure a safe and healthful learning environment.

1. Laboratory facilities should meet appropriate safety and health laws and regulations.
2. Safety zones and aisles should be properly marked.
3. Proper exhaust systems equipment, which removes fumes, should be provided.
4. Proper equipment should be provided to heat, cool, and ventilate all instructional and ancillary zones.
5. Approved safe cabinets, containers, or rooms should be provided to store flammable and corrosive materials.
6. Special safety and health accommodations should be provided for students with special needs.
7. Floors and all other surfaces should be kept free of waste material, grease, and obstructions.
8. Floors should have rubber mats or other types of non-conductive materials.
9. Each laboratory with powered equipment will have the equivalent of one easily accessible emergency disconnect switch (panic button).

*Standards for Industrial Arts Programs Project, Virginia Polytechnic Institute and State University, November 1981. (Revised to reflect Electricity/Electronics.)

10. Fire extinguishers of the correct class will be provided in appropriate locations.
11. A first-aid kit and related emergency supplies will be provided in accordance with local regulations.
12. Equipment will be selected on the basis of the ability to meet program objectives safely.
13. Machines and tools will be placed, mounted if necessary, and arranged in a safe and functional manner.
14. All machines and power tools will be provided with approved commercial guards and safety devices.
15. Safety guards will remain in place, except when the machine is disconnected for cleaning, repair, or adjustment.
16. Any machine or tool found to be unsafe will be removed from service until safety standards can be met.
17. Teachers and students will wear appropriate clothing when exposed to conditions which warrant such protection.

RECORDS: Records are on file to document the existence of an effective safety and health program.

1. Lesson plans documenting provision for safety and health instructions should be on file.
2. Results of written and performance tests and observations documenting student safety and health knowledge, attitudes, and skills are on file.
3. Inspection, maintenance, repair, and replacement records will be current and on file.
4. Records of each accident and the follow-up procedures taken will be on file.
5. Emergency procedures for responding to accidents will be posted and on file.

MAINSTREAMING IN ELECTRICITY/ELECTRONICS INDIVIDUALIZED EDUCATIONAL PROGRAMS (IEP)*

Included in Public Law 94-142 is the concept of individualized educational programs for handicapped students. Each student is to have an individually prescribed program of studies, containing short- and long-term goals, based on the diagnosis of the student's learning abilities. The law states:

> "A written statement for each handicapped child developed in any meeting by a representative of the local educational agency or an intermediate educational unit who shall be qualified to provide, or supervise the provision of, specially designed instruction to meet the unique needs of handicapped children, the teacher, the parents or guardians of such child, and whenever appropriate, such child, which statement shall include (a) a statement of the present levels of educational performance of such child, (b) a statement of annual goals, including short-term instructional objectives, (c) a statement of the specific educational services to be provided to such child, and the extent to which such child will be able to participate in regular educational program, (d) the projected date for initiation and anticipated duration of such service, and (e) appropriate objective criteria and evaluation procedures and schedules for determining, on at least an annual basis, whether instructional objectives are being achieved."

Since the electricity/electronics teacher will be involved in the planning and implementation of the instructional program for the particular electricity/electronics course in which the handicapped students are enrolled, the instructor should make every effort to participate actively in the development of the IEPs. This active participation will help to ensure that unrealistic or unreachable goals are not established for those phases of the students' programs which include the electricity/electronics teacher's area of expertise. Furthermore, planning appropriate instruction is crucial if handicapped students are to achieve their highest level of skill in the program. A side benefit of active participation in the writing of the IEP is the opportunity for working directly with the special education personnel, the students' parents, and the administration. Direct communication will help to prevent misunderstanding or confusion on the part of all parties involved.

One facet of the role of the electricity/electronics teacher, or any other teacher, is to provide information to appropriate persons for the identification of students with special needs. The major parts of the teacher's role, however, are those traditionally associated with helping students to learn - instructing and evaluating students. However, assisting students with special needs will probably require that the teacher reexamine methods, materials, motivational devices, and evaluation techniques.

*Courtesy of South-Western Publishing Company, Cincinnati, Ohio, Mainstreaming in Business Education, Monograph 135, March 1981. (Revised to reflect Electricity/Electronics Technology)

DIAGNOSIS

Two vitally important elements essential to the development of the IEP are those of diagnosis and task analysis. The task analysis is based upon the interpretation of the diagnostic reports pertaining to the handicapped student.

The individual with special needs must first be identified, tested, and evaluated for learning according to the diagnosis of the special need. Once the diagnostic reports are adequately interpreted, the development of an appropriate program begins. Acting cooperatively, the electricity/electronics teacher, special education resource persons, and other key professional staff members begin the process of planning the educational program for specific students. The basis for the planning is the development of the learner's profile which includes information about the student's learning strengths, weaknesses, and occupational interests.

TASK ANALYSIS

Inherent in the development of the IEP is the need for electricity/electronics teachers to realistically assess methods, media, and content pertinent to any given course or occupational cluster. For the first time, coordinators and teachers may realize that not every student needs to complete every part of one course.

A study should be made of available resources and the competencies required for work in today's society. Each individual program for a special needs learner is planned, implemented, and evaluated by a team composed of representatives from the areas of expertise mentioned earlier. Periodic assessment of the learner's progress is used to provide information not only of educational gains, but of the status of the handicapping condition.

A career cluster analysis is similar to a job or task analysis. The planners are identifying skills, knowledges, and basic competencies to be incorporated into the individualized instructional plans for the learner. Thus, the team must identify tasks and the essential knowledges and skills necessary for the performance of the task within designated occupational clusters and/or courses. Additionally, the team must determine the competencies and the levels of competency that can realistically be achieved by the special needs student.

COMPETENCY PROFILE FOR VOCATIONAL TEACHERS INSTRUCTING SENSORY AND PHYSICALLY IMPAIRED STUDENTS*

A. Develop a positive attitude toward working with sensory and physically impaired in the regular program.

1. Assess own attitude toward working with handicapped students.
2. Participate in activities simulating handicapped conditions.
3. Identify myths, misconceptions, and stereotypes.
4. Identify handicapping characteristics of students.
5. Identify economic indicators supporting hiring of the handicapped.
6. Consult with persons working successfully with the handicapped to determine why they are committed.
7. Observe the handicapped in successful roles (e.g., on the job).
8. Interact with handicapped students.
9. Review legislation concerning handicapped.
10. Persist in the face of seeming failure.

B. Implement modifications in the physical setting.

11. Identify architectural barriers.
12. Recommend needed changes in facility design.
13. Determine the special safety conditions that may be required by the handicapped students.
14. Modify work stations as needed.
15. Secure/adapt appropriate equipment as needed by students.

C. Modify curriculum and instruction.

16. Identify and verify vocational skills needed by each student to meet career goals.
17. Identify and verify related skills (reading, math).
18. Identify jobs on career hierarchy/ladder.
19. Match/modify jobs on career hierarchy/ladder to students' abilities.
20. Determine if texts/materials are appropriate to students' reading levels.
21. Adapt materials to individual learning styles.
22. Develop materials to meet individual learning styles.
23. Teach job-seeking skills.
24. Teach job-survival skills.
25. Modify length of training period to meet students' needs.
26. Promote use of open-entry/open-exit programming.
27. Use a competency-based grading system to supplement 'grade' with competency profile.
28. Employ alternative teaching practices (e.g., peer tutoring, small-group discussions).
29. Individualize teaching practices.

*Courtesy of South-Western Publishing Company, Cincinnati, Ohio, Mainstreaming in Business Education, Monograph 135, March 1981.

30. Use specialized language instruction techniques (e.g., to teach vocabulary).
31. Use a multisensory approach to instruction.
32. Adapt/use media for individual needs (e.g., captions).
33. Simplify instruction of essential tasks.
34. Identify instruction resources, materials, and techniques available to the teacher.
35. Use supportive instructional services.
36. Provide frequent reinforcement and success experiences.
37. Review effectiveness of curriculum and instruction regularly, and update as required.
38. Modify instructional evaluation techniques as needed.

D. Participate in ongoing evaluation concerning sensory and physically impaired.

39. Develop skills in recognizing students with handicaps.
40. Review any existing student records.
41. Devise informal measures for assessing students' abilities.
42. Identify student learning styles.
43. Assess students' motor skills in relation to occupational skills required.
44. Determine if the disability is, in fact, a vocational handicap.
45. Participate in development of individualized student plans (e.g., IEPs).
46. Involve students/parents on an ongoing basis.
47. Monitor and update student goals based on student progress.
48. Provide student with realistic picture of job skills needed and time required to reach career goal.

E. Develop effective communications.

49. Establish rapport with students.
50. Facilitate the productive integration of the disabled with their peers.
51. Assist students in developing realistic goal-setting skills.
52. Involve students in developing their own individual programs.
53. Provide assertiveness training for students.
54. Teach appropriate situational responses/discrimination skills.
55. Secure feedback from individual students on how well the program is meeting their needs.
56. Use student contracts (performance contracting, behavior contracting).
57. Relate self-awareness activities to career goals.
58. Develop functional means (e.g., sign language) to communicate with students having communication deficits.
59. Observe nonverbal behaviors as indicators of feelings.
60. Ensure that your communication patterns (verbal, nonverbal) do not single out handicapped students as different.
61. Use active listening techniques.
62. Work cooperatively with other support/resource persons (e.g., interpreter, itinerant teachers) in the classroom.

63. Maintain liaison with special education personnel as needed or required.
64. Communicate with guardians, employers, agencies, and all others affecting handicapped students.
65. Facilitate the placement of handicapped students by working with employer.
66. Encourage administrators to support creative/alternative instructional approaches.

F. Identify and utilize supportive services (on campus and in the community).

67. Identify needs students have.
68. Obtain or develop a directory of support services.
69. Participate in activities designed to increase your knowledge of what services do and how to use them.
70. Inform students of relevant services available to them.
71. Match students' needs with available services.
72. Identify appropriate contact persons for teachers.
73. Initiate referral process as appropriate (inform service, refer student).

G. Provide aid in emergencies.

74. Be alert to the types of emergencies that might occur for individual students.
75. Identify legal implications involved in giving aid.
76. Identify emergency procedures to be followed.
77. Obtain training in types of aid for individual students.
78. Identify/contact emergency resources.

H. Continue professional growth.

79. Work toward improving the climate for acceptance in yourself, in colleagues, and in employers.
80. Review related literature.
81. Participate in orientations and workshops.
82. Observe/interact with colleagues who are doing a model job in teaching handicapped students.
83. Participate in experiences that promote creative development and exchange (e.g., problem sharing with colleagues).
84. Participate in/support professional groups dealing with handicapped.
85. Include in your own professional development plans steps to acquire additional skills for teaching the handicapped.

DOD DEPENDENTS SCHOOLS
ELECTRICITY/ELECTRONICS PROGRAM
SELF-ASSESSMENT EVALUATION

SCHOOL: _____ DATE: _____

INSTRUCTOR'S NAME: _____ TYPE OF LABORATORY: _____

INSTRUCTIONS: Below is a list of evaluative statements. The teacher should rate each item from 0 to 4. Four is the highest rating an item may receive, 0 is the lowest. Once the evaluation is completed, the ratings should be totaled. The total possible score is 100 points. This instrument is intended for the teacher's use in program diagnosis. It is suggested that this instrument be used midway and at the end of this program.

PART I (Program):

Special concerns of the electricity/electronics program are common learnings needed by all persons to function effectively in our high technological society: attitudes, interests, abilities and skills, problem solving, and understanding the world of work.

Ratings		Statements
4 3 2 1 0	1.	The program (includes all courses) is designed to serve boys and girls providing hands-on activities interpreting the technology of our society.
4 3 2 1 0	2.	All levels of the program foster technological adaptability as an exit competency.
4 3 2 1 0	3.	Opportunity is offered each student to discover and to develop personal talents in the realm of technology.
4 3 2 1 0	4.	Courses enroll both boys and girls of all ability levels.

PART II (Curriculum):

Implementing a electricity/electronics program requires a division of services and responsibilities among the various levels, grades, facilities, and instructors.

4 3 2 1 0	5.	Individual courses are designed to be a part of a total program of instruction and are reviewed yearly for possible improvement.
4 3 2 1 0	6.	A written course of study is used to guide each class with activities designed to relate to the adaptability goal, the age, and the ability level of the students.

4 3 2 1 0	7.	The course of study lists exit competencies, i.e., what the student will have when he/she leaves the course.
4 3 2 1 0	8.	A student/personnel system is instituted for maintaining an orderly lab environment.
4 3 2 1 0	9.	A daily log or teacher plan book is maintained as a class instructional record.
4 3 2 1 0	10.	A record of pupil attendance in class is maintained.
4 3 2 1 0	11.	A record of individual student progress and activities is kept.
4 3 2 1 0	12.	A description of each course offered is included in a handbook of courses for use by students, parents, and guidance counselors.

PART III (Instruction):

Effective class instruction combines cognitive information and tactile activities designed to enable students to perform with ideas, tools, equipment, and materials.

4 3 2 1 0	13.	A lesson schedule, which includes 50 group presentations, is used with all classes.
4 3 2 1 0	14.	Teaching performance includes spontaneity, a relevant introduction, two-way communication, answerable questions, summation, and praise for participation.
4 3 2 1 0	15.	Students work without constant direction and/or questions.
4 3 2 1 0	16.	A variety of student project activities is evident.
4 3 2 1 0	17.	Provision is made for the display of student work.

PART IV (Facilities):

The presentation of instruction in electricity/electronics requires a laboratory environment with appropriate equipment/tools and an adequate supply of materials for student activity.

4 3 2 1 0	18.	Equipment represents a commitment to provide exploration in a wide variety of experiences rather than narrow, in-depth training.
4 3 2 1 0	19.	Guests and visitors routinely are invited and escorted to the electricity/electronics department as it represents a "showcase" environment for instruction.
4 3 2 1 0	20.	Storage of tools, materials, and projects is organized to provide full use of all benches and equipment and security for student work.
4 3 2 1 0	21.	Student clean-up activities are an integral part of the electricity/electronics course of study.

PART V (Safety):

Provision for instruction in common safety practices, the development of student safety habits and the establishment of a safe work environment represent a necessary part of technological education.

4 3 2 1 0	22.	Safety considerations are an integral part of all class and individual instruction.
4 3 2 1 0	23.	Equipment is fully guarded and procedures are implemented to assure compliance with good safety practices.
4 3 2 1 0	24.	Eye safety devices are worn as a common practice when warranted.
4 3 2 1 0	25.	A record of all accidents is maintained.

CERTIFICATE OF PROFICIENCY

in *is awarded*

to

This Day of_____ 19_____

_____
Principal

_____
School, Country

_____
Instructor

LIST COMPETENCIES ON BACK OF CERTIFICATE AND INITIAL EACH ONE.

*BASIC TEXTBOOKS FOR
ELECTRICITY/ELECTRONICS
(Approved for Adoption April 6, 1984)

TITLE	AUTHOR	PUBLISHER	COPYRIGHT DATE
EXPLORATORY, 6-8			
Experiences with Electrons	Miller	Southwestern Publ.	1983
ELECTRICITY, 7-12			
Residential Electrical Wiring	Miller	Bennett Publ. Co.	1981
ELECTRICITY/ELECTRONICS I, 9-12			
Electricity, Principles & Applications	Fowley	McGraw-Hill Co.	1984
ELECTRONICS II, 9-12			
Electronics, Principles & Applications	Shuler	McGraw-Hill Co.	1984
DIGITAL ELECTRONICS, 10-12			
Digital Electronics	Tokheim	McGraw-Hill Co.	1984
INDUSTRIAL ELECTRICITY, 10-12			
Industrial Electricity	Miller	Bennett Publ. Co.	1982
MICROPROCESSORS, 11-12			
Microprocessor-Micro-Computer Technology	Driscoll	Wadsworth Publ. Co.	1983
Microprocessors, Principles, Programming, And Interfacing	Muchow	Reston Publ. Co.	1983
INDUSTRIAL ELECTRONICS AND ROBOTICS, 11-12			
Robotics And Industrial Electronics	-------	Heathkit/Zenith Co.	1983

* For ordering these basic textbooks and other supplementary materials, refer to the DoDDS catalog.